ISSN (print) 0093-4666 © 2011. Mycotaxon, Ltd. ISSN (online) 2154-8889

MYCOTAXON

http://dx.doi.org/10.5248/118.273

Volume 118, pp. 273–282 *October–December 2011*

Observations on gasteroid *Agaricomycetes* from the Brazilian Amazon rainforest

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Abstract — Field trips carried out in an indigenous protected area in the states of Rondônia and Mato Grosso (Brazil) in 2009 revealed new records: *Geastrum albonigrum,* new from South America; and *Geastrum lageniforme*, *Mutinus caninus,* and *Tulostoma exasperatum*, new from the Brazilian Amazon rainforest. Descriptions, photographs, and line drawings of the specimens are presented.

Key words — *Basidiomycota*, fungal taxonomy, gasteromycetes, neotropical mycota

Introduction

The Amazon rainforest is recognized as one of the areas with higher biodiversity of the globe. Interesting data on macrofungal taxonomy from the Brazilian Amazon rainforest have been published recently by Desjardin & Braga-Neto (2007), Martins-Júnior et al. (2008), Gibertoni (2008), Gibertoni et al. (2008), Gomes-Silva et al. (2008, 2009, 2010a,b, 2011), Sotão et al. (2008), Gomes-Silva & Gibertoni (2009), Trierveiler-Pereira et al. (2009a), and Baltazar et al. (2010). However, gasteromycete diversity is poorly known in this Brazilian ecosystem.

Although more than two hundred species of gasteroid fungi have been acknowledged from Brazil (Trierveiler-Pereira & Baseia 2009), fewer than fifteen species are known to occur in the Amazon rainforest, an unexplored highly diverse area.

Species of gasteroid fungi previously recorded from the Brazilian Amazon forest are listed in Trierveiler-Pereira et al. (2009a), including the description of the new species, *Cyathus amazonicus* Trierveiler-Pereira & Baseia.

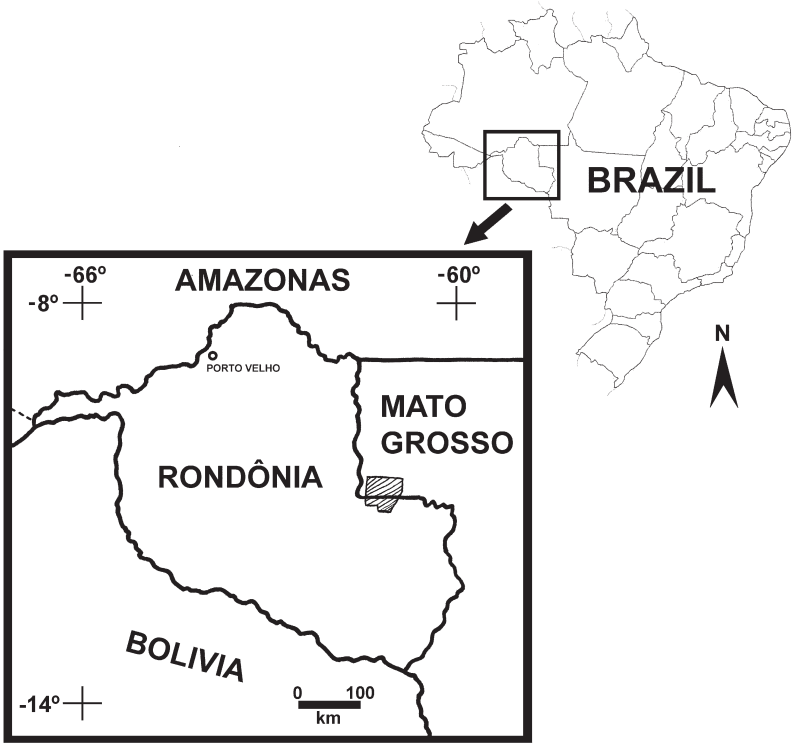

Fig. 1. Location of the 'Terra Indígena Sete de Setembro' (hatched area) in the states of Rondônia and Mato Grosso (Brazil).

Materials & methods

Fungi were collected along pre-existing trails in a Brazilian indigenous protected area called 'Terra Indígena Sete de Setembro' (TISS). This territory shelters ten indigenous tribes distributed in the states of Rondônia (RO) and Mato Grosso (MT) (Fig. 1). In this area there are about 1200 indigenous individuals from the ethnic group of Paiter-Suruí. The TISS extends over approximately 249 thousand hectares and its territory is mostly covered by the Amazonian dense ombrophilous forest (Radambrasil 1978, Ferronato & Nunes 2010).

Field trips were carried out from May 28th to June 06th 2009 in the tribal areas 'Sertanista Apoena Meirelles' (Rondolândia, MT; 10°10′15″S 59°28′14″W) and 'Lapetanha' (Cacoal, RO; 11°26′19″S 61°26′50″W).

The collected basidiomata were placed in paper bags or plastic containers prior to analysis. Macroscopic descriptions are based on observations of fresh and dried material (Miller & Miller 1988). Colors are coded according to Kornerup & Wanscher (1978). Microscopic observations of tissues from dried specimens mounted in 5% KOH were made under a light microscope.

Voucher specimens were deposited in the Herbarium HFSL and duplicates were sent to Herbarium URM. Additional specimens deposited in MA-Fungi, ICN, and MBM were also examined. Gasteromycete specimens cited in Capelari & Maziero (1988) were borrowed from the Herbarium SP to confirm identification. Herbarium acronyms are according to Thiers (2011).

Taxonomy

Geastrum albonigrum Calonge & M. Mata, Bol. Soc. Micol. Madrid 28: 332. 2004. Fig 2, 4a

Specimens examined: **BRAZIL. Mato Grosso**, Rondolândia, Terra Indígena Sete de Setembro, Aldeia Apoena Meirelles, 30.V.2009, leg. Gomes-Silva et al. 209 (URM 82098).

Immature basidiomata epigeous, globose to ovoid, 2.1 cm high × 1.5 cm broad, grayish brown (4C5) to yellowish brown (5F5), hirsute, with a single robust rhizomorph attached at the base, rhizomorph ramified or not, 0.6–1.8 cm length, with debris strongly attached. Expanded basidiomata 0.7–1.9 cm high × 2–3.4 cm broad. Exoperidium non-hygroscopic, split into 6–7 rays, saccate or with rays becoming involute, more rarely arched; external layer hirsute, grayish brown (4C5) to yellowish brown (5F5), peeling off at maturity; fleshy layer persistent, brown (6E5) to grayish brown (6E3), with a purplish shade. Endoperidium globose to depressed globose, 0.7–1.6 cm high × 1.2–1.6 cm broad, brown (6E6), sessile, without apophysis; peristome fibrillose, not delimited, slightly darker than endoperidium. Gleba pulverulent at maturity, dark brown (6F4).

Basidiospores globose, 4–4.5 µm diam. (including ornamentation), yellowish brown to dark brown in KOH, ornamented with short columns. Capillitial hyphae straight, thick-walled, with narrow lumen, pale brown to yellowish brown in KOH, 3–6 µm diam., not branched.

Ecology & distribution: Gregarious on rotten wood, without subiculum. The Brazilian material represents the first record from South America. Previously known from Costa Rica, Mexico, and Panama. It is possible that the species occurs in neotropical rainforests and warmer regions of temperate America.

Additional specimens examined: **COSTA RICA. Guanacaste**, Tempisque, Parque Nacional Palo Verde, 27.IX.2003, leg. I. López 4869 (MA-Fungi 59260, **isotype**); 20.X.2004, leg. I. López 6277 (MA-Fungi 65423); **MEXICO. Chiapas**, Tapachula, 03.X.1993, leg. G. Guzmán 30743 (MA-Fungi 59258); **PANAMA. Isla de Coibas**, Cerro de la X, 14.XII.1996, leg. Pando & Núñez (MA-Fungi 36140-2).

Remarks: *Geastrum albonigrum* is characterized by an epigeous hirsute form when young, a saccate or involute exoperidium that peels off in age, a sessile endoperidium, and a non-delimited fibrillose peristome. When the dark hirsute external exoperidial layer peels off, it reveals a white fibrous layer

where the rhizomorph remains attached. The fleshy layer is purplish and the endoperidium is dark.

Brazilian material differs from the holotype in spore measurements (3–5 µm in the original description) and the presence of a narrow lumen in the capillitial threads (absent in the material described by Calonge & Mata 2004).

Geastrum albonigrum belongs to the group of epigeous xylophilous *Geastrum* species, such as *G. schweinitzii* (Berk. & M.A. Curtis) Zeller, *G. hirsutum* Baseia & Calonge, and *G. javanicum* Lév., all of which differ by forming a white subiculum over the substrata (Ponce de León 1968, Baseia et al. 2003, Baseia & Calonge 2006), a character not seen in *G. albonigrum*.

Geastrum hirsutum also has a hirsute exoperidium that peels off at maturity, but lacks a robust rhizomorph, has a delimited peristome, and a light-colored endoperidium and fleshy layer. Similar to *G. hirsutum, G. schweinitzii* produces smaller basidiomata lacking a hirsute external layer. *Geastrum javanicum* has no hirsute external layer and it rarely peels off completely (Trierveiler-Pereira et al. 2011).

Geastrum lageniforme Vittad., Monogr. Lycoperd.: 16. 1842. Fig 3a, 4b

Specimens examined: **BRAZIL. Mato Grosso**, Rondolândia, Terra Indígena Sete de Setembro, Aldeia Apoena Meirelles, 30.V.2009, leg. Gomes-Silva et al. 206, 222 (URM 82099, 82100).

Immature basidiomata not observed. Expanded basidiome 0.7–1.0 cm high × 2.3–3.0 cm diam. Exoperidium non-hygroscopic, split into 6–8 rays, saccate, rays long, slender, external layer glabrous, with longitudinal ridges, grayish yellow (1B5) to blond (4C4); fleshy layer persistent, brownish gray (6C2). Endoperidium globose, 0.7–0.9 cm high × 1.0–1.2 cm broad, grayish beige (4C2) to brownish gray (5D2), sessile, without apophysis; peristome fibrillose, grayish brown (5E3), delimited by a whitish line. Gleba pulverulent at maturity, brownish gray (5E2).

Basidiospores globose, 3.5–5 µm diam. including the ornamentation, yellowish brown in KOH, ornamentation columnar. Capillitial hyphae straight to more or less sinuous, slightly thick-walled, with narrow lumen, yellowish in KOH, 2.5–8.0 µm diam., not branched.

Ecology & distribution: Solitary on forest soil. Widespread (Calonge et al. 2004). In Brazil, the species has been reported from the states of Rio Grande do Sul (Rick 1961, Cortez et al. 2008), Rio de Janeiro (Hennings 1904), Bahia (Trierveiler-Pereira et al. 2009b), and Pernambuco (Trierveiler-Pereira et al. 2011). This is the first record from the Brazilian Amazon rainforest.

Additional specimen examined: **SPAIN. Burgos**, Quintana del Pidio, 22.XI.1991, leg. L.A. Parra (MA-Fungi 30752).

Remarks: *Geastrum lageniforme* resembles *G. saccatum* Fr. in a saccate exoperidium, sessile endoperidium, and fibrillose delimited peristome (Trierveiler-

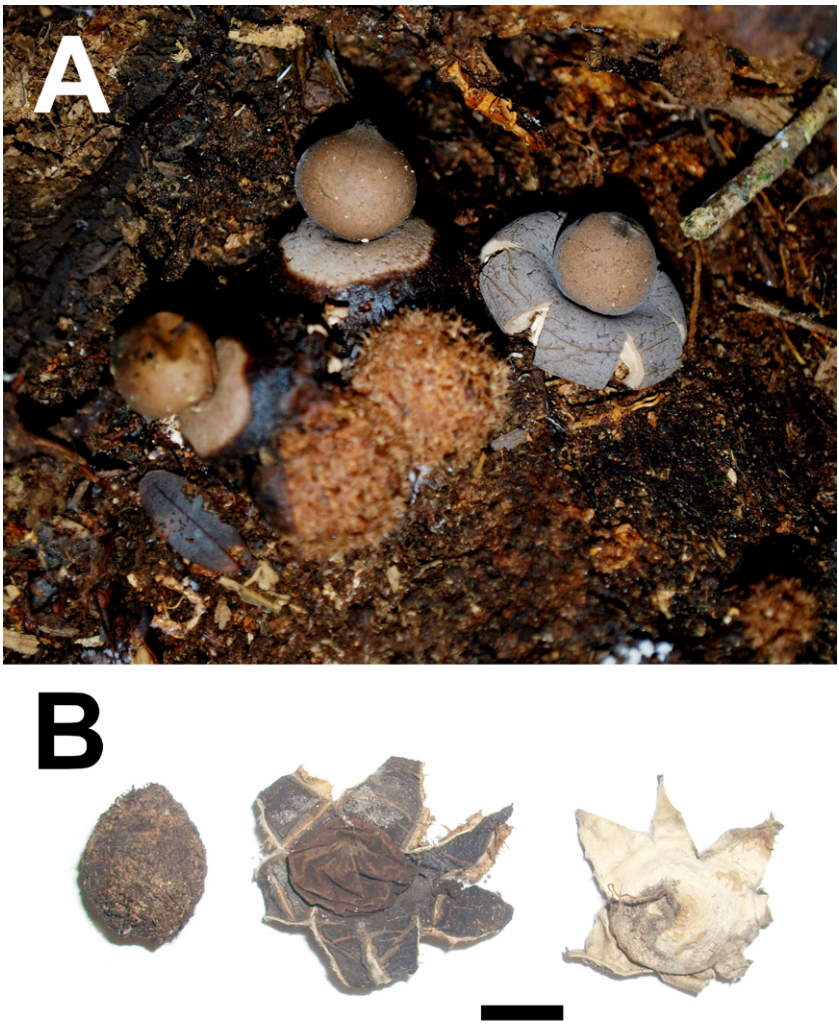

Fig. 2. *Geastrum albonigrum*.
A. Mature and immature basidiomata in situ.
B. Basidiomata in different stages of development.

Pereira et al. 2011). According to Sunhede (1989), the two species can be distinguished by the presence of clamped hyphae in the external mycelial layer, which occur only in *G. lageniforme*.

Ponce de León (1968) considered *G. lageniforme* a synonym of *G. indicum* (Klotzsch) Rauschert (= *G. triplex* Jungh.), but there are characteristics that can separate these two species, since *G. triplex* is usually larger, with involute rays, and forms a fleshy collar around the endoperidium.

Mutinus caninus (Huds.) Fr., Summa Veg. Scand. 2: 434. 1849. Fig 3c, 4c

Specimen examined: **BRAZIL**. **Rondônia**, Cacoal, Terra Indígena Sete de Setembro, Aldeia Lapetanha, 05.VI.2009, leg. Gomes-Silva et al. 126 (URM 82101).

Basidiome 5.5 cm high, with a whitish rhizomorph attached at the base, rhizomorph ramified, up to 2.2 cm long. Volva saccate, 1.6 cm high × 1 cm broad, yellowish white (1A2). Pseudostipe cylindrical, tapering at the apex, 4.1 cm high × 0.7 cm broad, spongy, light orange (5A4) at the base and becoming reddish towards the apex, fertile region reddish orange (7B8). Gleba mucilaginous, olive brown (4F5), covering the fertile region.

Basidiospores cylindrical, 4.5–5.5 × 1.5 µm, hyaline to greenish in KOH, smooth, biguttulate.

Ecology & distribution: Solitary on forest soil. Cosmopolitan, but rare in the tropics (Baseia et al. 2006). In Brazil the species was reported only from Rio Grande do Norte (Baseia et al. 2006). This is the first record from the Brazilian Amazon rainforest.

Additional specimens examined: ***Mutinus caninus*** – **SPAIN**. **Guipuzcoa**, San Sebastián, 16.X.1976, leg. Sociedad de Ciencias Naturales Arazandi (MA-Fungi 22361). ***Mutinus elegans*** – **SPAIN**. **Lugo**, Chantada, 03.XI.1999, leg. M.T. Jacobo s/n (MA-Fungi 42064); **BRAZIL**. **Rio Grande do Sul**, Viamão, Parque Estadual de Itapuã, 22.V.2004, leg. V.G. Cortez 016/04 (ICN 139004).

Remarks: *Mutinus caninus* is similar to *M. elegans* (Mont.) E. Fisch. but forms a well delimited gleba on the apical zone; the glebal zone is not defined in *M. elegans* (Calonge 1996). The pseudostipe in the examined material is yellowish, but according to Calonge (1996) it may also be whitish or pinkish. Zeller (1944) described a white variant of this species, *M. caninus* var. *albus* Zeller.

Tulostoma exasperatum Mont., Ann. Sci. Nat., Bot., Sér. 2, 8: 362. 1837. Fig 3b, 4d

Specimens examined: **BRAZIL**. **Rondônia**, Cacoal, Terra Indígena Sete de Setembro, Aldeia Lapetanha, 06.VI.2009, leg. Gomes-Silva et al. 100, 145 (URM 82102, 82103).

Basidiomata 1.1–7.0 cm high. Spore sac globose to depressed-globose, 0.6–0.8 cm high × 1.8–2.2 cm broad. Exoperidium spiny, light brown (5E7), peeling off at maturity. Endoperidium reticulate, papery, yellowish white (2A2) to pale yellow (4A3); peristome conical, slightly lighter than endoperidium, fibrillose, delimited. Gleba dull yellow (3B3). Stipe 0.9–6.1 cm high × 0.2–0.25 cm diam., light brown (5E7), with longitudinally arranged scales.

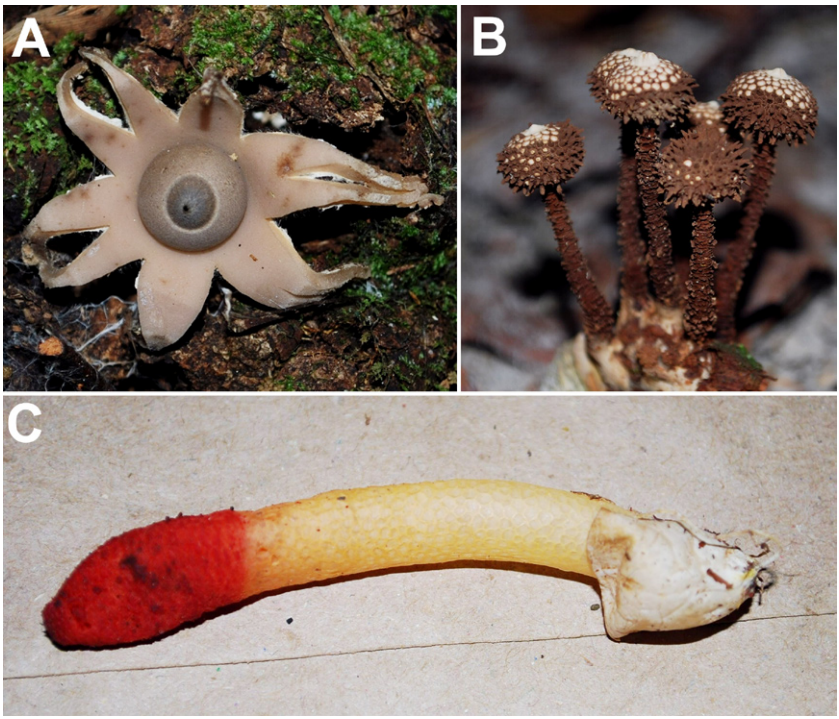

Fig. 3. Gasteroid species from the Brazilian Amazon rainforest.
A. *Geastrum lageniforme*. B. *Tulostoma exasperatum*. C. *Mutinus caninus*.

Basidiospores globose to subglobose, 6–7.5 µm diam., yellowish in KOH, with a columnar-reticulate ornamentation. Capillitial hyphae straight to tortuous, thick-walled, swollen at the septa, branched, light yellow in KOH, 4–7 µm diam.

Ecology & distribution: Gregarious on rotten wood. Widely distributed in tropical and subtropical regions (Wright 1987). In Brazil the species is known from Rio Grande do Sul (Rick 1961, Cortez et al. 2009), Paraná (Meijer 2006), Paraíba (Silva et al. 2007), São Paulo and Pernambuco (Baseia & Milanez 2002). This is the first record from the Brazilian Amazon rainforest.

Additional specimen examined: **BRAZIL**. **Rio Grande do Sul**, Viamão, Parque Estadual de Itapuã, 25.VI.2005, leg. R.M. Silveira 456 (ICN 154635); **Paraná**, Tibagi, Quartela, 06.IX.1992, leg. A.A.R. de Meijer 2341 (MBM).

Remarks: Among the 14 *Tulostoma* species recorded from Brazil (Baseia & Milanez 2002, Meijer 2006, Silva et al. 2007, Cortez et al. 2009), *T. exasperatum* is the only one with a lignicolous habit. *Tulostoma* species usually occur on sandy soil, pastures, humus, forest soil and even flooded areas (Wright 1987).

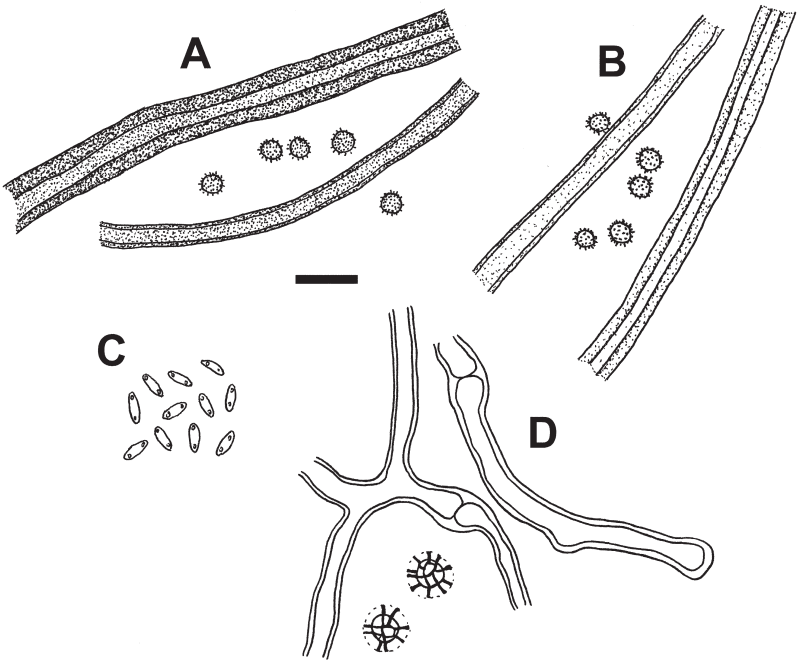

Fig. 4. Line drawings of microscopic elements.
A. *Geastrum albonigrum*: capillitial threads and spores.
B. *G. lageniforme*: capillitial threads and spores. C. *Mutinus caninus*: spores.
D. *Tulostoma exasperatum*: capillitial threads and spores (scale bar = 10 µm).

Specimens kept in SP

We reviewed and confirmed the identities of the following gasteromycetes previously reported from the Brazilian Amazon rainforest by Capelari & Maziero (1988): SP 211544, SP 211545, SP 211547, and SP 211548 as *Cyathus montagnei* Tul. & C. Tul.; SP 214636 as *C. limbatus* Tul. & C. Tul.; and SP 211223 and 211526 as *Morganella fuliginea* (Berk. & M.A. Curtis) Kreisel & Dring. The immature basidiomata in SP 211549 could not be identified morphologically. We did not review SP 211527 (labelled as *Morganella* sp.) or SP 211301 (labelled as *Lycoperdon* sp.).

Acknowledgments

We thank the people of Paiter; 'Associação Metareilá do Povo Indígena Suruí'; 'Equipe de Conservação da Amazônia – ACT Brasil'; 'Associação de Defesa Etnoambiental Kanindé' and 'Fundação Nacional do Índio (FUNAI)'. The United States Agency for International Development (USAID) is acknowledged for financial support. We also would like to thank the curators of SP, ICN and MBM for specimen loans and

Dr. Francisco D. Calonge (CSIC, RJB de Madrid) for the access to the MA-Fungi exsiccata. LTP acknowledges PROPESQ ('Pró-Reitoria para Assuntos de Pesquisa e Pós-Graduação', UFPE) and PPGBF ('Programa de Pós-Graduação em Biologia de Fungos', UFPE) for financial support. We are grateful to Admir J. Giachini (Universidade Federal de Santa Catarina, Brazil) and André A.R. de Meijer (Paraná, Brazil) for critically reading the manuscript.

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